THE EFFECTIVE DEPTH OF IMPROVEMENT OF ROLLING DYNAMIC COMPACTION

Compiled as one of the requirements to complete the Undergraduate Study Program in the Department of Civil Engineering, Faculty Engineering

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THE EFFECTIVE DEPTH OF INFLUENCE OF ROLLING DYNAMIC COMPACTION

Abstract

This research is about determining the depth to predict the effectiveness of rolling dynamic compaction (RDC) as a ground improvement in clay and sand ground. Among numerous other soil compaction strategies, RDC may be a broad strategy, which includes affecting the ground with an overwhelming (6 to 12 tones) non-circular (3,4&5 sided) module. It gives the development industry a modified ground compaction capability, particularly with respect to a more prominent impact profundity and a better speed of compaction, coming about in expanded efficiency when compared with conventional compaction gear. While routine circular rollers are able to compact layer thicknesses regularly within the extend of 200 mm to 500 mm, thicker layers are able to be compacted utilizing RDC. Be that as it may, the profundity of impact of RDC can shift altogether depending on the soil sort, dampness substance, free layer thickness and number of passes. A solid and precise prescient show for RDC, pertinent in a extend of ground conditions, will enable geotechnical engineers to create a priori gauges of the viability and the profundity of impact related with affect rolling. Indeed, forecasting the influence of RDC is complex due to the heterogeneous nature of the ground and the various site-specific factors that can potentially affect the improvement process. This study centers on the 4-sided module and points to measure the adequacy of RDC by implies of a combination of field of study and numerical modeling on diverse sorts of soil which is found in Australia. The effectiveness of RDC on different soil types, number of passes, layer thickness, and Depths of improvement for RDC are summarized in this paper. Finally, new definitions: the Major depth of improvement and the effective depth of improvement are analyzed and discussed, then summarize the factors affecting on RDC based on the previous studies.

Keywords: Australia, depths of improvement, different types of soil, ground improvement, rolling dynamic compaction (RDC).

Abstrak

Penelitian yang dipaparkan dalam penelitian ini berfokus pada penentuan kedalaman untuk meramalkan efektifitas rolling dynamic compaction (RDC) sebagai perbaikan tanah pada tanah lempung dan pasir. Di antara banyak metode pemadatan tanah lainnya, RDC adalah teknik tersebar luas, yang melibatkan pemadatan tanah dengan modul berat (6- 12 nada) non-lingkaran (3-, 4- dan 5-sisi). Ini memberi industri konstruksi kemampuan pemadatan tanah yang lebih baik, terutama sehubungan dengan kedalaman pengaruh yang lebih besar dan kecepatan pemadatan yang lebih tinggi, yang menghasilkan peningkatan produktivitas bila dibandingkan dengan peralatan pemadatan tradisional. Sementara roller melingkar mampu memadatkan ketebalan lapisan yang biasanya berkisar antara 200 mm hingga 500 mm, lapisan yang lebih dapat dipadatkan

menggunakan RDC. Namun, kedalaman pengaruh RDC dapat bervariasi secara signifikan tergantung pada jenis tanah, kadar air, ketebalan lapisan lepas dan jumlah lintasan.
Model prediktif yang andal dan akurat untuk RDC, yang dapat diterapkan dalam berbagai kondisi tanah, akan memungkinkan para insinyur geoteknik membuat perkiraan apriori tentang efektivitas dan kedalaman pengaruh yang terkait dengan dampak rolling. Memang, peramalan pengaruh RDC adalah kompleks karena sifat tanah yang heterogen dan berbagai faktor spesifik lokasi yang berpotensi mempengaruhi proses perbaikan. Studi ini berfokus pada modul 4 sisi dan bertujuan untuk mengukur efektivitas RDC melalui kombinasi studi lapangan dan pemodelan numerik pada berbagai jenis tanah yang terletak di Australia. Efektivitas RDC pada berbagai jenis tanah, jumlah lintasan, ketebalan lapisan, dan Kedalaman perbaikan untuk RDC dirangkum dalam makalah ini. Akhirnya, definisi baru: Kedalaman utama perbaikan dan kedalaman efektif perbaikan dianalisis dan dibahas, kemudian merangkum faktor-faktor yang mempengaruhi RDC berdasarkan studi sebelumnya.

Kata kunci: Australia, berbagai jenis tanah, kedalaman perbaikan, perbaikan tanah, rolling dynamic compaction (RDC).

1. INTRODUCTION

1.1 Background

The ground, which involves soils and rock, by its nature, exhibits varied and uncertain behavior because of its formation and variability. However, sometimes, these ground variabilities impose limitations upon which constructions are affected. Thus, geotechnical engineering often deals with problematic soil conditions, where ground improvement techniques are often necessary. Currently, there are more than 30 different ground improvement techniques (Phear and Harris, 2008), which can be broadly categorized into 5 main groups: removal, compaction, consolidation, modification and load transfer. Amongst this Impact rolling, is a well-established method of soil compaction where the soil densification is achieved by means of high energy impacts. RDC uses non-circular (3, 4&5 sided) heavy (6 to 12 ton) modules that rotate around their corners and fall to the ground as they are dragged forward behind a tractor.

The 4-sided impact roller module consists of a steel casing which is completely filled with concrete to produce the non-circular solid mass with rounded corners. A feature of the 4-sided impact roller is that it incorporates a double-linkage spring system, and is connected to the impact roller frame and the module's axle. The double-spring linkage system provides additional energy to initiate rolling and compact the ground. The module rotates eccentrically around its corners as the impact roller traverses the ground and falls to the adjacent face of the square-shaped mass resulting in a series of high amplitude impact blows delivered onto the ground at a low frequency of 90 to 130 blows per minute (Pinard, 1999). As such, the revolution of the roller mass continues and impact blows are delivered onto the ground at regular intervals.

Consequently, RDC enables the impact roller to impart a greater amount of compressive energy on to the soil.

As such:

- RDC is effective since it improves the ground to a depth of more than one meter beneath the ground surface and sometimes deeper than 3 m in some soils; compared to conventional static and vibratory compaction, where the influence depths are generally less than 0.5 m (Clifford, 1976, 1978b; Avalle and Carter, 2005; Jaksa et al., 2012);
- RDC can condense thicker lifts of over 0.5 m, which is significantly more than the usual layer thicknesses of around 0.3 m, enhancing RDC's economic effectiveness. (Avalle, 2006; Scott and Jaksa, 2012);
- RDC can be used to increase a soil's shear strength and stiffness while also lowering its permeability.
- RDC is also particularly efficient when used in broad and open areas since it travels at speeds of 9–12 km/h, which is far faster than traditional compaction methods such as utilizing a vibratory roller, which travels at 4 km/h.
- RDC is used in a variety of applications around the world, including (i) construction industry for in situ densification and subgrade proofrolling, (ii) in the agricultural sector mainly for the improvement of existing water storages, channels and embankments, (iii) in the mining industry for the construction of tailing dams, rock rubblisation in open cut mine waste tips and the compaction of capping over waste rocks.

Figure 1. Rolling dynamic compaction in the form of a 4-sided impact roller: (a) in use in landfill application; (b) cross-section. [Bouazza Abdelmalek & AvalleDerek Luigi (2006)]

It has been identified that with the impact roller mechanism has the potential to fully transfer the kinetic energy to the ground as indicated by the cessation of the drum motion immediately after an impact blow (Avalle, 2004d). As described earlier, due to the combination of potential and kinetic energy derived from the impact mechanism, together with the large mass of the module, RDC produces a greater amount of compactive effort than traditional (i.e. non-dynamic) compaction techniques. Consequently, the soil beneath the surface is densified into a state of lower void ratio by expelling the pore air and fluid.

RDC often leads to deeper influence depths, in excess of 3 m below the ground surface in some soils (Avalle and Carter, 2005), which is substantially deeper than conventional static and vibratory compaction, where influence depths are often less than 0.5 m below the ground surface. This was demonstrated by Pinard (1999) using a nail/hammer analogy, as illustrated in Figure 2. It is evident that RDC accounts for high load intensity and a large surface area of the compactor module in comparison to the static and vibratory compactors, coupled with a high amplitude/low frequency operation mode which results in RDC developing deeper influence depths than those of other conventional compaction methods (Pinard, 1999).

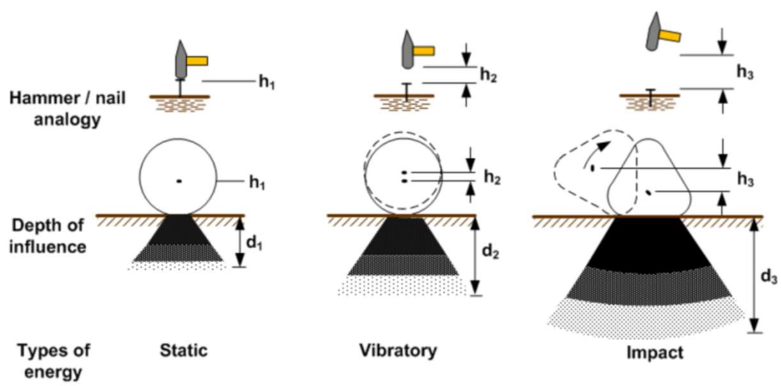

Figure 2. Effectiveness of different compaction methods with respect to the nail/hammer analogy [Pinard (1999)].

Table 1. Values of ratio of energy (k) for various towing speeds according to change in potential and kinetic energies

v: km/h	*mgh*: kJ	ΔKE: kJ	*mgh* + ΔKE: kJ	*k*
9	11·8	10·0	21·8	1·8
10·5	11·8	13·6	25·4	2·2
12	11·8	17·8	29·6	2·5

Where:

V: speed (Km/h)

ΔKE: kinetic energy alteration (kJ)

Mgh: gravitational potential energy (kJ)

K: proportion of the energy conferred to the ground partitioned by gravitational potential energy.

Production:

Production of compacted fill:

$$P_{compact} = \frac{Wr \times v \times h}{n\ passes} \tag{1}$$

Where:

$P_{compact}$: Rate of production (m3 /h)

W_r : Roller width (m)

V : Speed (km/h)

h : Thickness of the consolidated layer (mm)

n_{passes} : The number of passes required to meet the compaction requirements.

1.2 Problem

Various studies, including Avalle and Carter (2005), Avalle (2007), Avalle et al. (2009), and Jaksa et al. (2010), have focused on quantifying the effectiveness of RDC through field experiments (2012). Mentha et al. (2011) conducted a study with three primary objectives(a) the use of earth pressure cells (EPCs) for direct stress change measurements in order to evaluate the RDC's depth of effect and stress distribution; (b) conducting field tests, such as dynamic cone penetration tests (DCPs) and field density measurements, as well as using the spectral analysis of surface waves (SASW) geophysical methodology to measure and infer density changes as a function of module passes; and (c) characterizing the soil by performing a series of laboratory tests on the samples collected from the site (e.g. particle size distribution, hydrometer test, Atterberg's limits, standard and modified Proctor tests).

The success of RDC is thought to be largely reliant on the soil type and site conditions, as evidenced by results from field-based studies. Due to inherent variances between sites and how the level of improvement is both defined and quantified, the influence depth is often a measure of the depth to which the imposed load from the module quantitatively influences the soil. For example, in botanical sands, Avalle and Carter (2005) observed a depth of improvement of around 1.4 m, whereas in calcareous sands, Avalle (2007) reported a depth of 7 m. Furthermore, time and budget constraints usually limit the number of field experiments that may be conducted. Table 1 summarizes published case studies employing typical four-sided impact rollers that improved the ground in situ and compacted dirt in thick layers.

Table 2. Improvement depths for RDC for different soil material type.

REFERENCE	YEAR	SOIL TYPE	Improvement Depth (m)
Califford	1978	Sand	>2,5
Califford	1978	Sand	>2
Avall and Young	2004	Fill (clay)	1
Avall	2004	Fill (sand)	>2
Avall and Grounds	2004	Fill (Mixed)	1,5
Avall	2007	Fill (Sand)	2,5
Scott and Suto	2007	Fill (Gravelly clay)	1,5

1.3 Scope of research

- The current study attempts to fill the aforesaid knowledge gap by developing an accurate and robust predictive in situ test model for prior prediction of RDC effectiveness using the following methods:
- Constant surface wave system (CSWS)
- Dynamic finite element modeling (FEM) software LS-DYNA.
- Earth pressure cells (EPCs)
- The cone penetration test (CPT)
- Artificial neural networks (ANNs) and genetic programming are examples of artificial intelligence (AI) methodologies (GP)This research is based on five published case studies in Australia that involved standard four-sided impact rollers that improved the ground in situ and compacted dirt in thick layers in a variety of soil conditions.

1. An old trash tip site was redeveloped using rolling dynamic compaction (RDC). Surface wave measurements show that the RDC has been effective in improving the strength of the

material below ground surface, the improvement is concentrated to depths ≤ 2 m. The successful application of the RDC resulted in a cost-effective and environmentally sustainable solution.

2. The next research aims to assess the effectiveness of RDC (4-sided module) by using field studies which is earth pressure cells placed at different depths and numerical modeling using the dynamic finite element analysis software (FEM), LS-DYNA. The results of both studies was same that the improvement is between depths of 0.8 m to 3.0 m below the ground surface.
3. Using a four-sided impact roller, Scott, Brendan, and Jaksa conducted a field testing. Earth pressure cells (EPCs) were implanted at various depths, and the depth of improvement was found to be more than 2m beneath the ground surface.
4. The ground reaction to rolling dynamic compaction (RDC) was investigated in the laboratory. To assess impact stress at various depths, earth pressure cells (EPCs) were inserted in the sand sample. It was discovered that 15 passes of the RDC could yield a depth improvement of 2.5 m for dry loose sand.
5. This paper discusses how the cone penetration test (CPT) was used as a key site investigation technique to quantify the zone of influence of ground improvement using RDC at a site involving sand fill, and it is found that the effective depth of influence is >1,75 m below the surface.

1.4 Research objectives

This study aims to investigate and quantify the effectiveness of RDC in a range of ground conditions and seeks to establish predictive in situ mode to determine the effective depth for each type of soil.

RDC's variable and unclear depth of influence is one of the main reasons why it isn't utilized more frequently, and it underscores the need for more research.

Specifically, this thesis aims to:

- Summarize various studies about RDC on clay and sandy soil, by using different in situ test: CSWS, FEM, EPCs, CPT, AI.
- Compare and analyze from the previous studies the effective depth of improvement for RDC on sandy and clay soil.

- Discuss the difference between the major depth of improvement and the effective depth of improvement, because they are not same.
- Develop and establish a set of general factors that effect on the effectiveness of RDC in the term of the depth of improvement

2. METHOD

In this thesis, a literature study method will be adopted by collecting data from different references have been done in Australia. A detailed analysis for each reference and the model used to quantify the effectiveness of RDC and determine the improvement depth.

The introduction provides a brief overview of the conventional soil compaction methods followed by a detailed assessment of RDC, highlighting its advantages, Energy, production and applications. Then a review of the existing literature regarding the estimation of the effectiveness and depth of influence of RDC is also given.

The field tests and measurement techniques used for the verification of ground improvement by RDC are then briefly discussed.

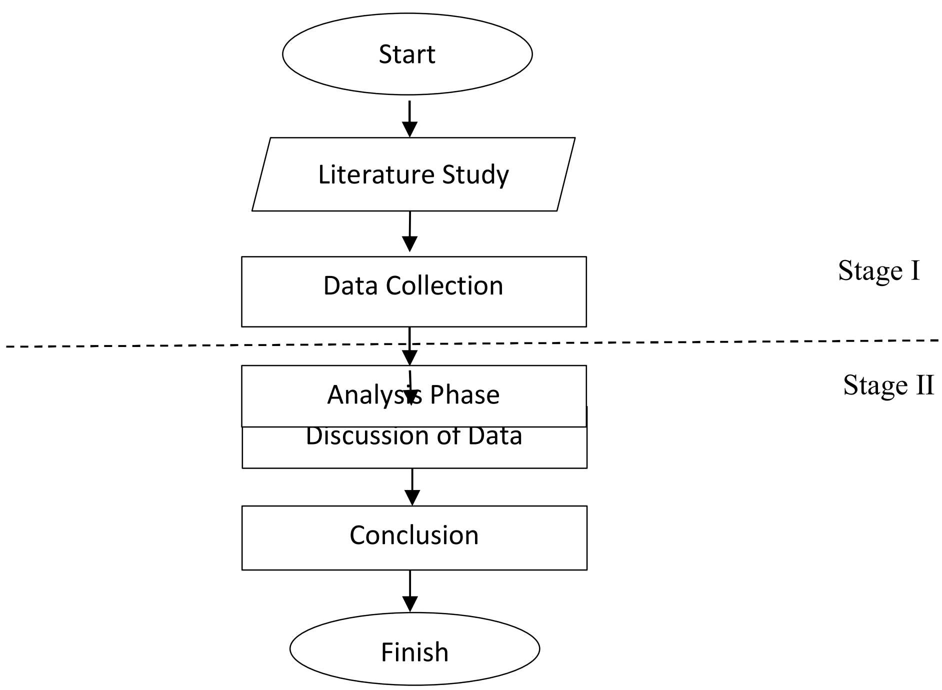

Figure 3. Flowchart of Experiment

3. RESULTS AND DISCUSSION

3.1 General review of the references: literature review

There are several instances in the literature where RDC has been examined experimentally through field-based studies with the intention of investigating the degree of densification and the extent of influence depth in different ground conditions. Some of the recent research studies that have evaluated the effectiveness of the 4-sided impact roller (BH-1300) are briefly discussed below.

3.1.1 Clay soil analysis:

- **The Constant Surface Wave System (CSWS)**

Bouazza & Avalle (2006) evaluated the ground improvement caused by impact rolling from a field study conducted in an old waste tip forms part of a clay and former basalt quarry. To determine the impact of RDC on the environment, the author conducted research on the relationship between peak particle velocity and scaled energy over distance from the impact point measured in the waste fill, resulting in the conclusion that RDC-induced ground vibrations are not disturbing to people.

A ratio of 2 has been used in this investigation.

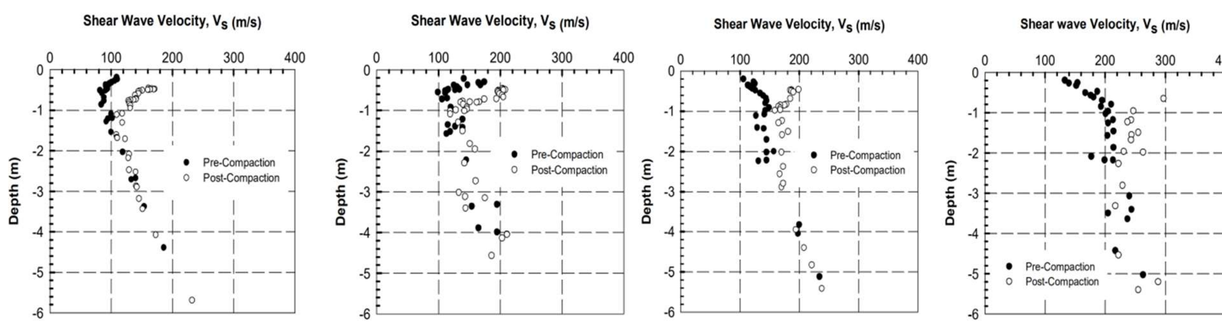

Figure 4. Shear wave velocity versus depth at different locations [Bouazza & Avalle (2006)]

The compaction efficacy was measured using a constant surface wave system (CSWS). In four locations, shear wave velocity measurements were collected before and after the dynamic compaction process to analyze waste material stiffness parameters. It’s clear from figure.4 that shear wave velocity increased after compaction until the depth of 2m then the V_s is almost same in both Pre-consolidation and post-consolidation. The findings show that the majority of the improvement occurs at the surface (to depths of less than 2 m).

The Cone Penetration Tests (CPT)

In addition, Scott and Jaksa (2014) conducted a field study involving a compaction trial that investigated both the vertical extent and lateral zone of influence of RDC again by means of the CPT. The site was described to be comprised of predominantly quartzose and carbonate sand (thickness of the compacted fill was 1 m) underlain by natural soil of stiff to hard silty clay. Figure 5 shows a typical result comparing qc before and after rolling An increase in soil shear strength was quantified by increasing cone tip resistances in the sandy fill layer and to a depth of approximately 0.75 m into the underling natural clay (total depth of 1.75 m). The fill and natural soil interface at a depth of 1 m below the ground surface was clearly identified in the CPTs. Based on the measurements of CPTs undertaken to a minimum depth of 2 m, it’s found that the influence depth extended to at least 1.75 m below the surface after 10 impact roller passes.

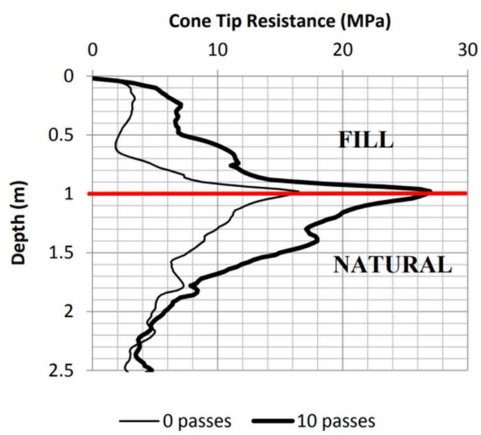

Figure 5. The variation of cone tip resistance with depth before and after 10 passes of impact roller [Scott and Jaksa (2014)]

- **The Artificial Intelligence (AI) by using Cone Penetration Test.**

Ranasinghe and M. B. Jaksa presented a study on the use of artificial intelligence (AI) techniques such as artificial neural networks (ANNs) and genetic programming (GP) to estimate the density enhancement by RDC in a clay ground a priori. For the (ANN) and linear genetic programming (LGP) models incorporating CPT data, the output variable, Cone tip resistance after compaction (q_{cf}), is examined, while the input variables of Cone tip resistance prior to compaction (q_{ci}), Sleeve friction prior to compaction (f_{si}), No. of Roller Passes (P) and Depth of measurement (D) are varied. For the depth it’s clear that at <2m the strength value is almost stable with least decrease. When comparing Figures 6 (a) and (b), it is clear that qcf only improves significantly as fsi rises from 50 to 100 kPa, whereas qci remains constant at 2 or 5 MPa. As a result, fsi appears to have a lower impact on qcf. Nonetheless, the parametric investigation shows that both models have adequately represented the peculiar non-linear relationship between qcf and P.

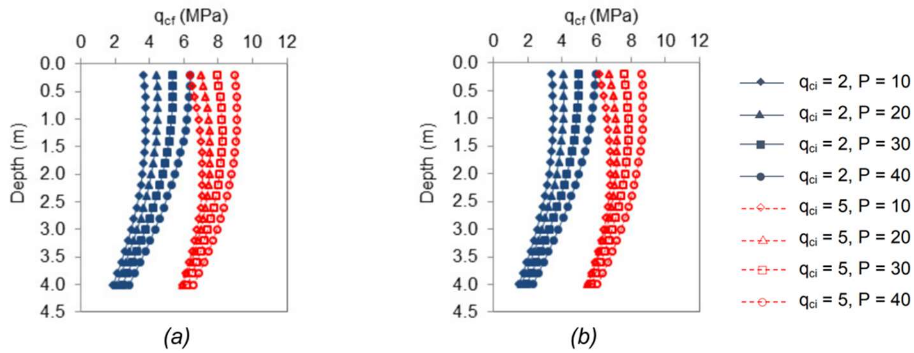

Figure 6. ANN model prediction of qcf for varying q_{ci} (MPa) and number of roller passes, P when: (a) f_{si} = 50 kPa; and (b) f_{si} = 100 kP [Ranasinghe and. Jaksa (2016)]

3.1.2 Sandy soil analysis

- **The Dynamic Finite Element Analysis Software (FEM)**

Using a combination of field tests and numerical modeling, several researchers attempted to assess the efficiency of RDC on well graded sand (SW) with modest quantities of gravel-sized material (14%) and clay fines (6%) with low plasticity in 2013. Earth pressure cells were embedded at various depths beneath the ground and the in situ stress was measured during a range of module passes in the field studies. The depth of improvement was measured in the field to be more than 2 meters below the ground surface.

The depth of improvement was measured in the field to be more than 2 meters below the ground surface. LS-DYNA, a dynamic finite element analysis software (FEM), was used for numerical modeling.

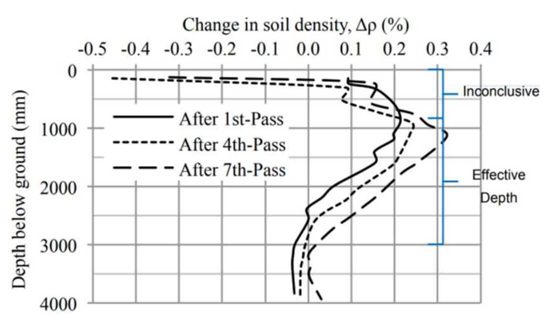

Figure 7. FEM predicted change in soil density versus depth after single and multiple passes [Jaksa (2013)].

From figure.7 it can be observed that increased number of passes results increase in density between depths of 0,8m and 3m, above depth of 0,8m the results were inconclusive, This indicates that the compaction for the top layer of soil is inefficient; BELOW a depth of 2.5 m (3.0 m in Figure.7), the varying numbers of passes begin to converge, suggesting that this is the depth of influence of the roller for which there is quantifiable improvement.

- **Earth pressure cells (EPCs)**

Zhongqing Chen and Yue Lv (2017) also attempted to investigate the depth of influence based on Earth pressure cells (EPC) applied at Shanghai dry sand. Particle image velocimetry (PIV) was employed to acquire the moving picture of sand particles during the RDC. Earth pressure cells (EPCs) were placed in the sand specimens to assess impact stress at various depths.

The test findings show that 15 passes of the RDC can generate a 2.5 m improvement depth for dry loose sand, with the horizontal improvement breadth of the single impact being 0.8 to 1.2 times the length of impact spacing.

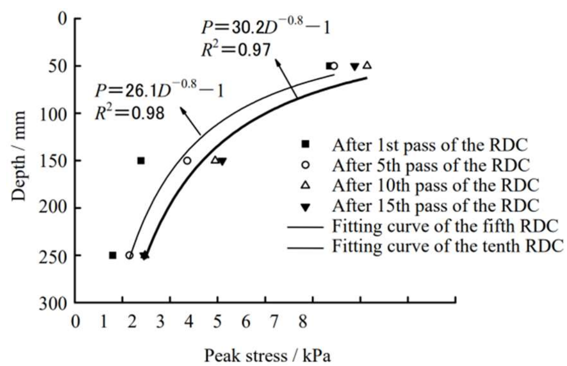

Figure 8. Measured peak stresses at impact center by different passes of the RDC [Zhongqing Chen and Yue Lv (2017)]

More recently, Scott, Brendan & Jaksa, Mark & Mitchell, Peter (2020) conducted a field study to investigate the depth of influence of rolling dynamic compaction (RDC) at the Iron Duke mine located on the Eyre Peninsula in South Australia on a well-graded sand (SW).

Figure 5 shows how measured peak pressure varies with depth, with peak pressures larger than 100 kPa being reported at depths more than 2.0 m.

Other test data revealed that the majority of the quantifiable ground improvement happened within 2 m of the surface, which the EPC results generally supported.

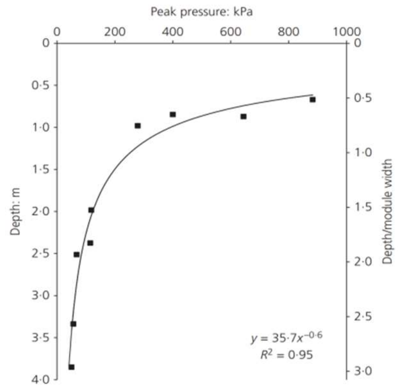

Figure 9. Measured peak pressure against depth with trend line fitted to data

Table 3. The influence depth of clay and sandy soil with different models by using Rolling Dynamic Compaction

	RESEARCHER	YEAR	SOIL TYPE	MODEL	NUMBER OF ROLLER PASSES	DEPTH
Clay soil	Bouazza Abdelmalek & AvalleDerek Luigi	2006	Clay and basalt quarry	constant surface wave system (CSWS)	-	≤ 2 m
	Scott, Brendan & Jaksa, Mark.	2014	Clay	cone penetration tests (CPTs)	10 passes	≥ 1,75 m
	R. A. T. M. Ranasinghe and M. B. Jaksa	2016	Clay	Artificial intelligence (AI)	10, 20, 30 and 40 passes	< 2 m
Sandy soil	Zhongqing Chen and Yue Lv	2017	Sand	Earth pressure cells (EPCs)	1, 5, 10 and 15 passes	2,5 m
	Kuo, Yien Lik & Jaksa, Mark & Scott, Brendan & Bradley, Andrew & Power.	2013	well graded sand (SW)	The dynamic finite element analysis software (FEM)	1, 4 and 7 passes	≥2 m
	Scott, Brendan & Jaksa, Mark & Mitchell, Peter	2020	well graded sand (SW)	Earth pressure cells (EPCs)	0, 8 and 16 passes	≥2 m

3.2 Discussion

Because there are several in situ approaches that can be used to quantify it, the influence depth of RDC can be interpreted differently and is unexpected in current practice. In essence, the accuracy of these estimations is dependent on the quality of the pre- and post-compaction tests performed. Furthermore, the intricate nature of the impact roller's functioning, as well as the ground's subsequent reaction, has made RDC's performance complex. The degree of soil compaction is determined by several elements, including the soil's intrinsic physical features, such as dry density, moisture content, soil type, and gradation; the thickness of the compacted soil layer; and the compactive effort.

As the low influence stress at greater depths may only cause soil to deform elastically, resulting in no change (or improvement) in soil density upon load removalhere should distinguish , :between 2 types of depths

First is the Major Improvement depth (MDI) is a more appropriate measure of the effectiveness of the impact roller, as it is a function of soil type, site characteristics and the weight and operating speed of the RDC module. It's the depth at which RDC improves the density and shear strength of the soil, as well as the maximum layer thickness that can be compacted in thick lifts.

Effective Influence Depth (EDI): To put it another way, the depth of influence is the depth to which any improvement in density or reduction in void ratio is seen, independent of magnitude. The term "effective depth of improvement" (EDI) is most commonly used to describe the process of improving ground in situ. The EDI can be thought of as the maximum depth at which significant progress can be made. The depth of influence zone (or influence depth) refers to the depth of soil impacted by the load imposed at the ground surface, as well as the improvement depth over which the soil undergoes significant density and shear strength improvements owing to RDC. According to Slocombe (2004), the depth of influence is not equal to the depth of improvement. A reduction factor, r, is employed to estimate the zone of considerable improvement from the EDI. As defined in equation, DMI is equal to r (a constant ranging from 0 to 67) multiplied by the EDI (2).

$$DMI = r\ (EDI). \qquad (2)$$

3.3 Factors affecting the efficacy of RDC.

It is evident from the RDC case studies described above, that the extent of the influence depth in different ground conditions is unpredictable, from 6 different studies about sand and clay soil, it was found that the depth vary although for the same soil types, for example the results of clay soil, the improvement depth was <2m, and for sandy soil was >2m, because it is likely to be affected by various site-specific factors and especially by the heterogeneous nature of the soil. These factors are briefly described below.

Soil Type: Soils used for earthwork compaction vary considerably from project to project, particularly in terms of their geotechnical characteristics and particle size range. However, one of the strengths of RDC is that it can work with a wide range of earthworks materials (Avalle, 2004b). Generally, filling or in situ subgrade material may consist of large oversized particles such as rock or rubble, or well or poorly graded coarse- or fine-grained materials, or sometimes organic materials. Nonetheless, several studies have confirmed the RDC behaviour and its applicability on different types of soils.

Compactive Effort: Compactive effort is the amount of energy imparted to the ground, which can be considered as a function of lift thickness, number of roller passes, machine speed, weight and height of the drop. However, for a given compaction situation, most of these parameters are fixed for a particular module type and thus, the compactive effort is determined solely on the number of roller passes. From the previous studies was found that when applying more roller passes is the more strength get it.

The moisture content and the dry density: are also extremely important among the factors associated with compaction. It is well known that soil type, moisture content, compactive effort and dry density are related to one another via a series of compaction curves, the field trial conducted by Scott et al. (2012) indicated that a greater dry density can be achieved for lower moisture content with a higher compactive effort (represented by the number of roller passes) and this is beneficial in earthworks compaction. However, as shown in the Figure 10, with the increasing amount of compactive effort in terms of number of blows, the gain in dry density decreases and the additional blows begin to have little or no effect on the dry density. Thus, It is essential to maintain the right amount of compactive effort that is both effective and efficient in terms of the optimal moisture content and maximum dry density.

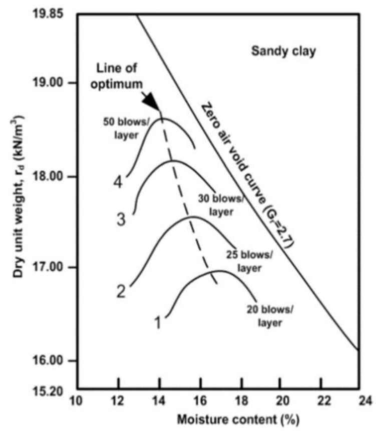

Figure 10. Variation of dry density with number of rollers passes. [Scott et al. (2012)]

4. CONCLUSION

This study discussed and compared previous studies about the effectiveness of rolling dynamic compaction on clay soil and sandy soil located in Australia by using different in situ models. It was found that determining the depth of improvement is very complicated to determine for each type of soil, where, for clay soil the improvement depth is less than 2m however for sandy soil is more than 2m. The depth varies because of three main reasons: Soil type, Compactive effort (Number of rollers passes) and the moisture content and the dry density. Although the performance of RDC is complex but it is confirmed that it's applicable on different soil types, and enhance the improvement.

Based on the results of the previous studies which summarized in the table 2, it's evident that the RDC is more applicable on sandy soil, where the depth of improvement is more than 2m, and that because of the physical properties of the sandy soil and that the permeability is higher than clay soil, so that makes the compaction more efficient and can reach high depth of improvement.

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